Integrating Climate Resilience in Renewable Energy Investments in the North Sea

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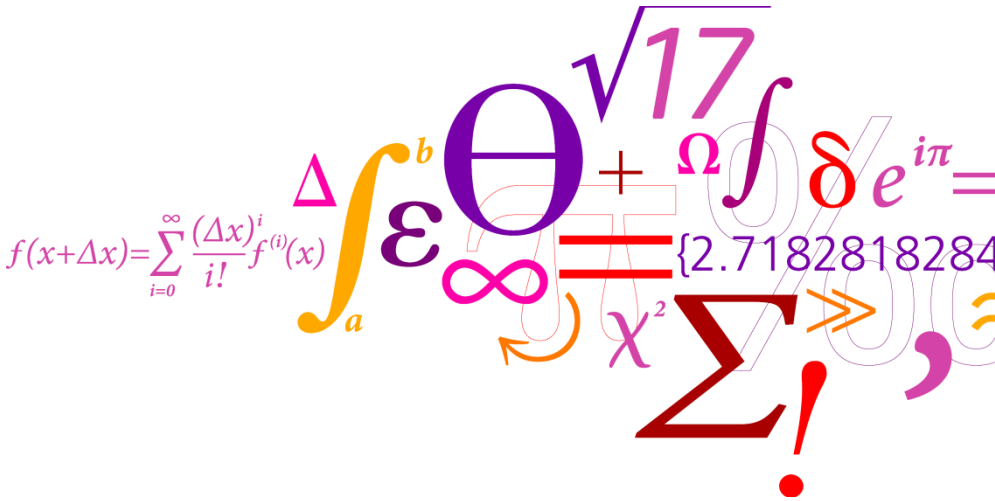


DTU Management Engineering
Department of Management Engineering

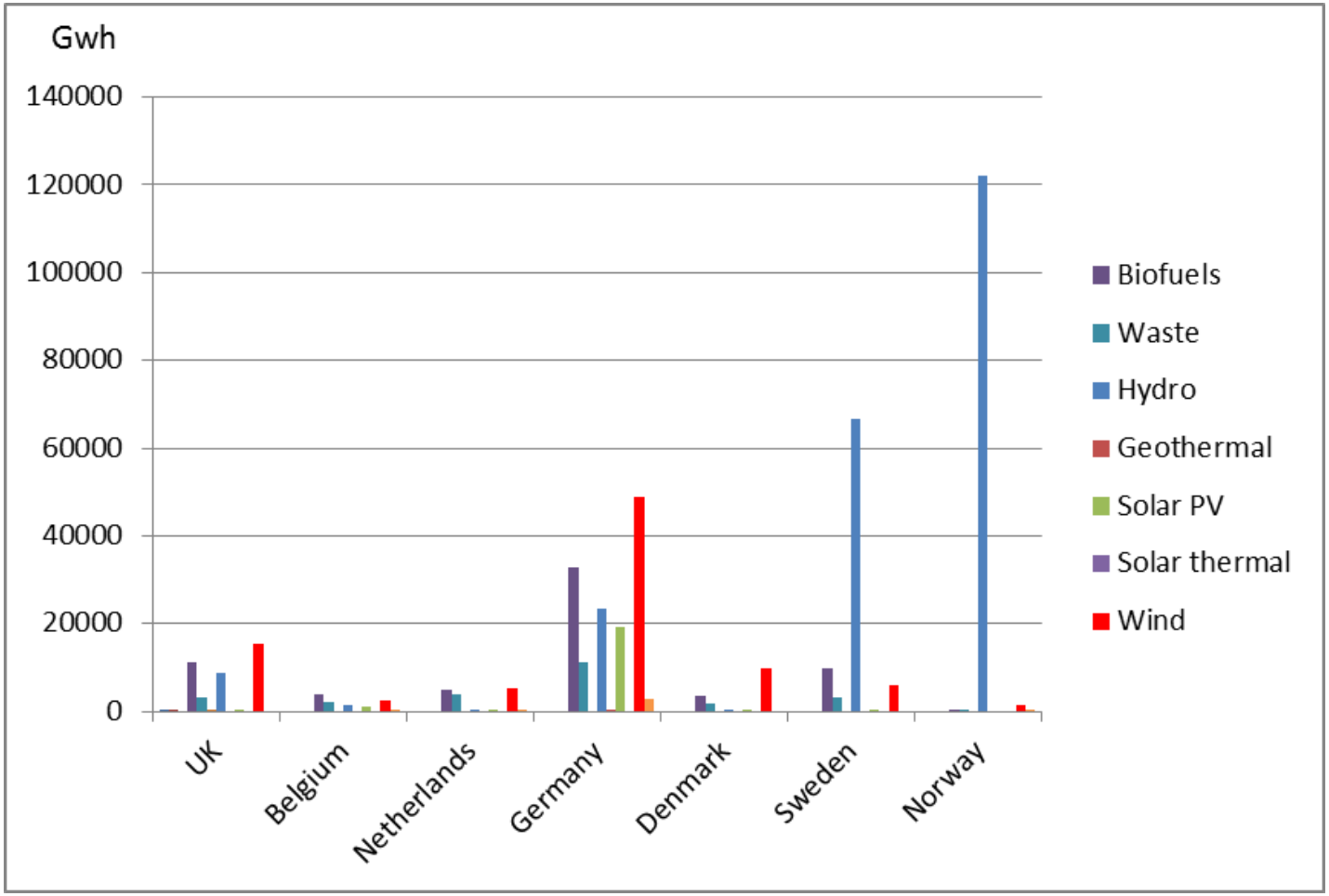
Structure

- Renewable energy sources in the North Sea energy systems
- Vulnerabilities of the renewable sources:
  - Key vulnerabilities
  - Location of plants
  - Potential risks on individual plants
  - Integrated system vulnerabilities (synchronic shocks)
- Coping strategies:
  - Climate proofing of investments: options for individual technologies
  - Climate proofing of systems: Storage, backup, technology portfolio
- Markets and finance
- Research ideas

Key Vulnerabilities

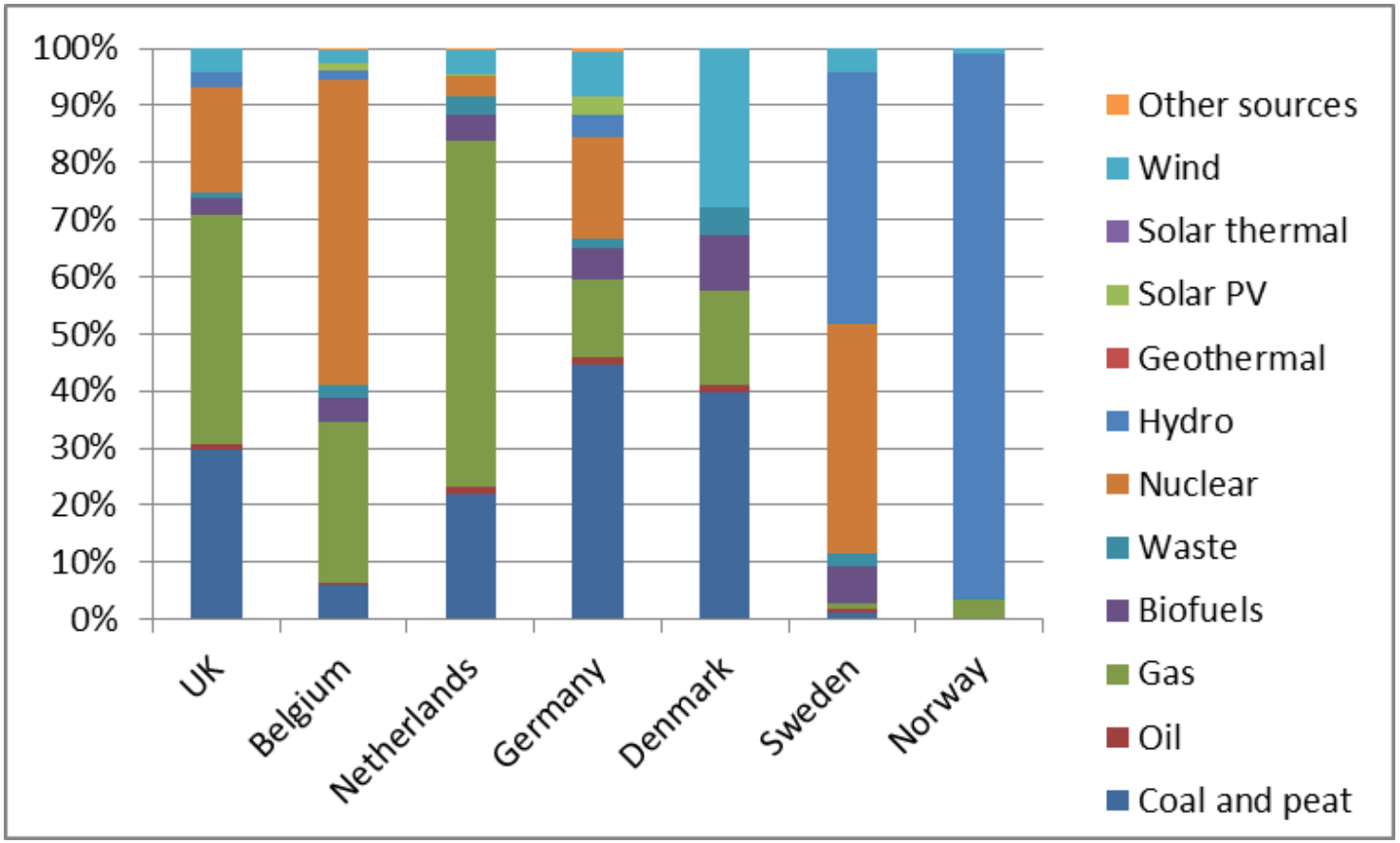
	Gradual Climate Change	Extreme Weather Events
Hydro Power	Increases/decreases in potential Changed seasonal availability	Damages on dams
Wind Power	Less frequent icing Dust from precipitation Flooding at coastal sites	Material damage with storms
Solar Power	Lower efficiency of PV with higher temperature Higher efficiency of SH with higher temperatures	Material damage with storms, hail and heavy precipitation
Biofuels	Changed productivity and new crops	Loss of harvest due to draught or storms

Renewable Electricity Production in the North Sea Region 2011



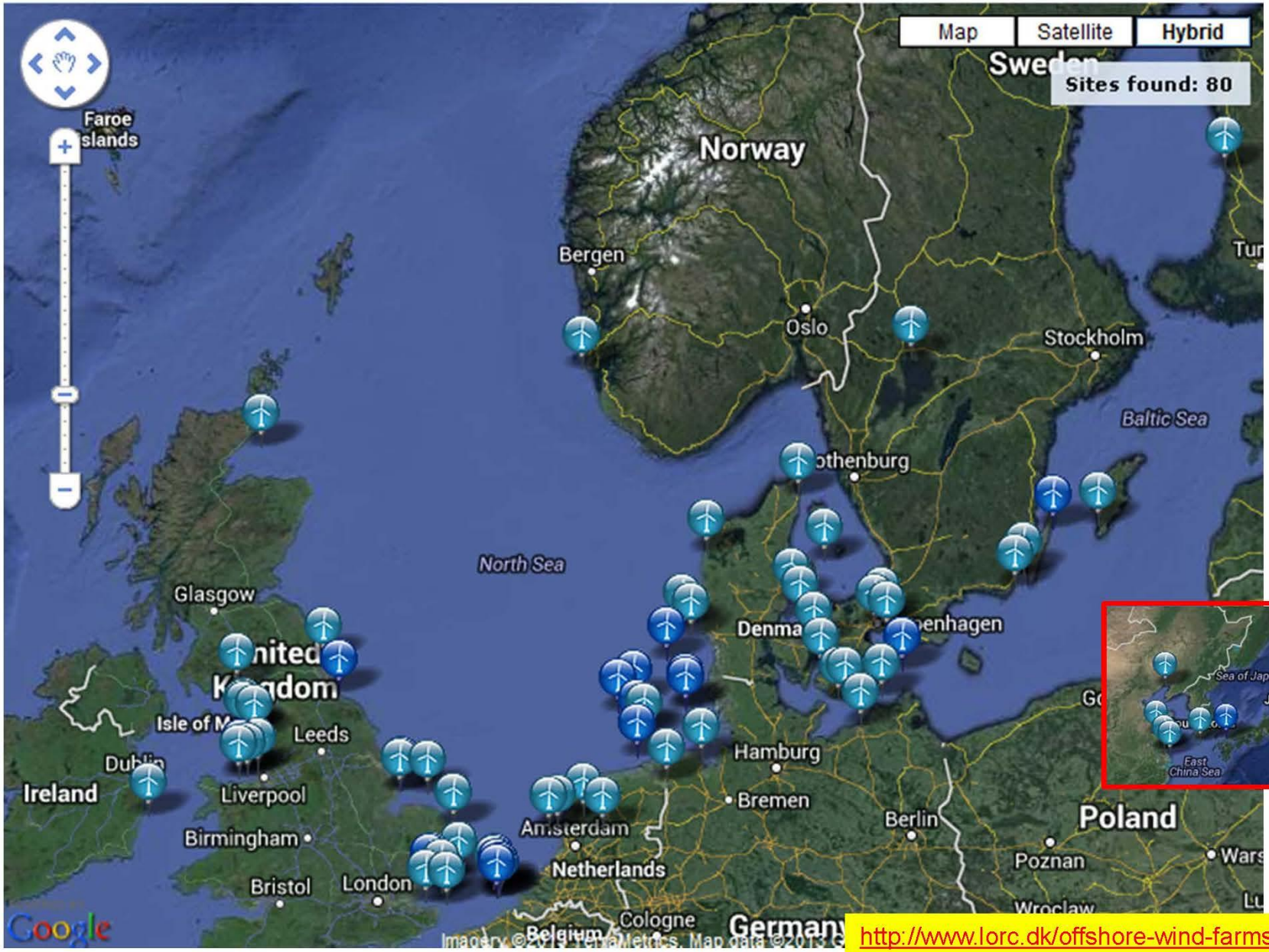
IEA, Electricity Statistics 2011

National Shares of Renewable Electricity Production in the North Sea Region



IEA, Electricity Statistics 2011

Offshore wind farms 2013



http://www.lorc.dk/offshore-wind-farms-map

Economic Potential for New Offshore Wind

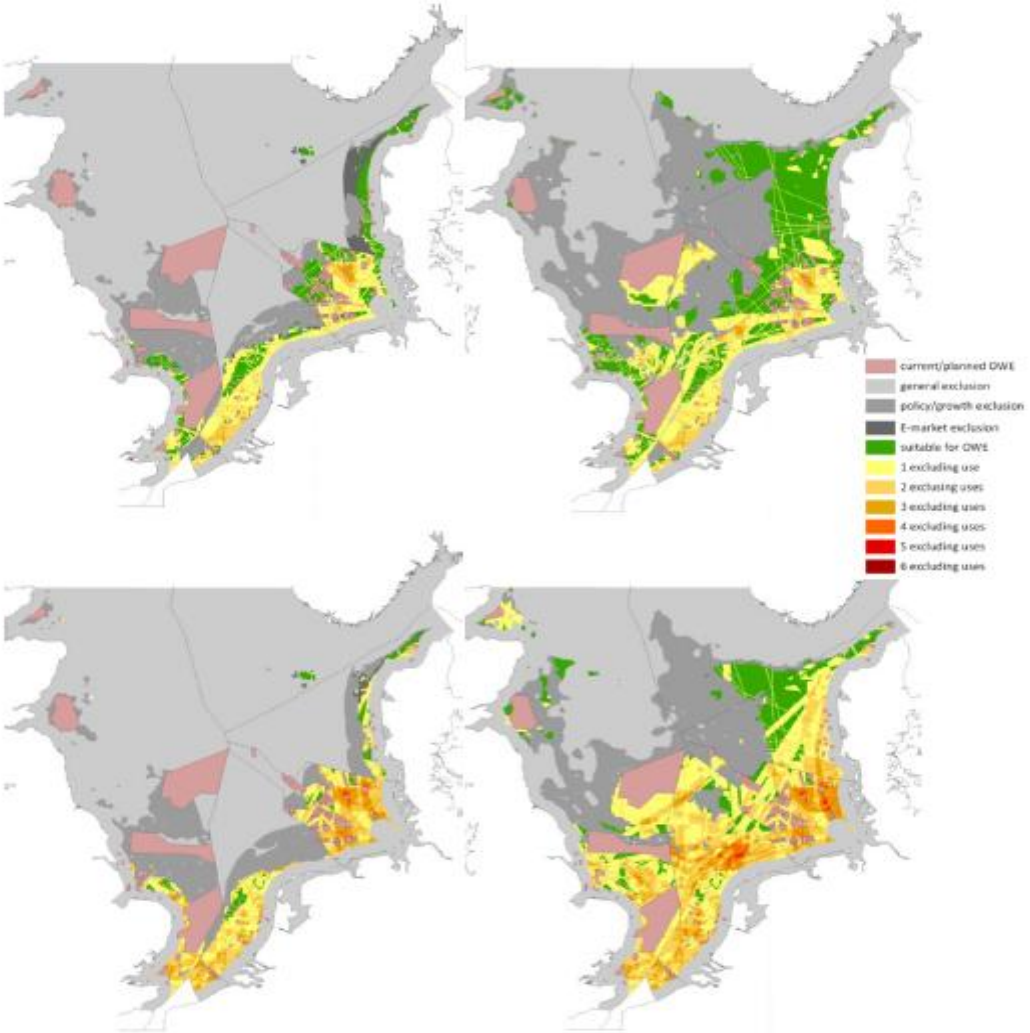
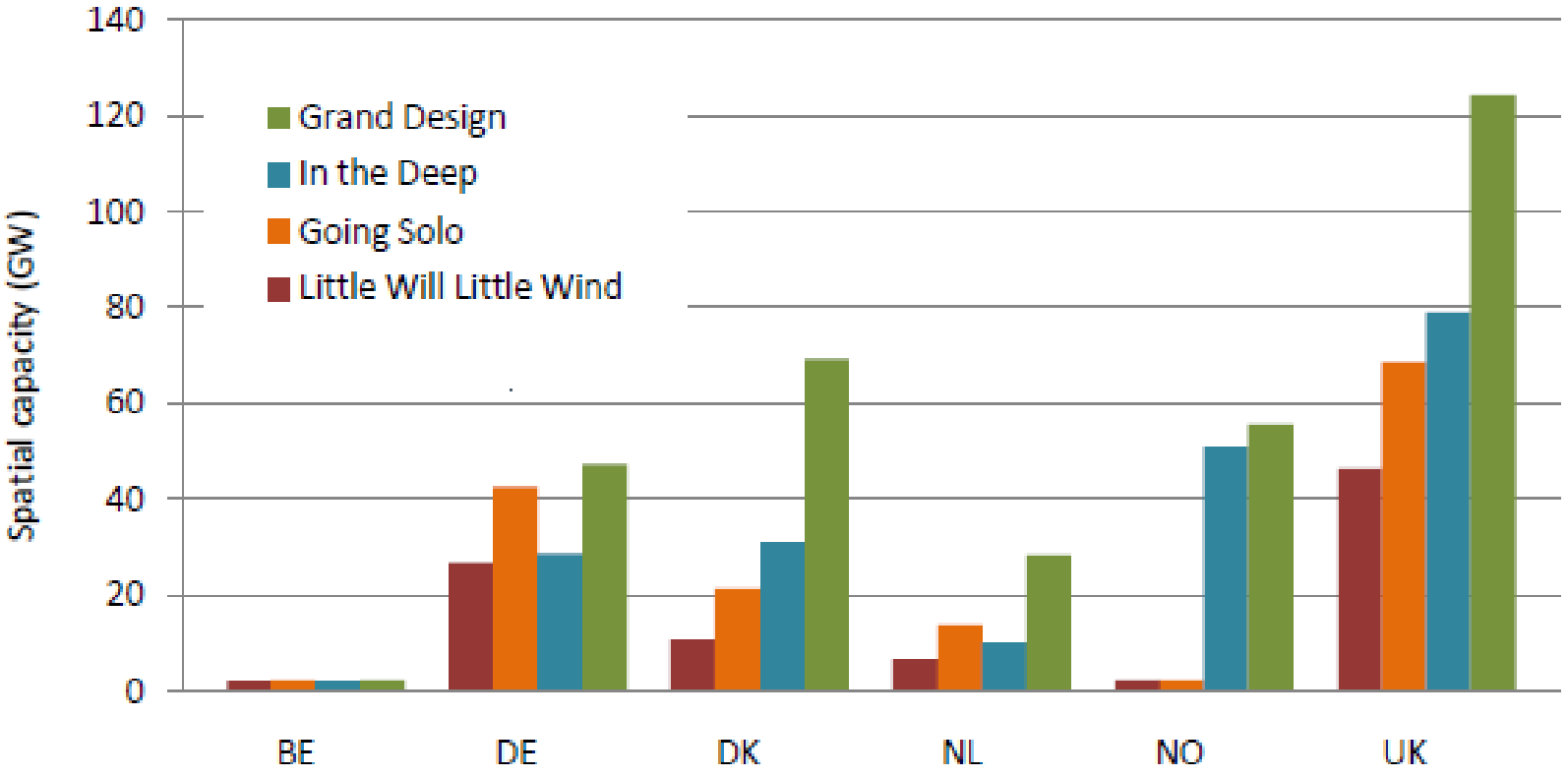


Figure 15: Map of economic potential in the WINDSPEED area for each scenario: Little Will Little Wind [bottom left], Going Solo [top left], In the Deep [bottom right] and Grand Design [top right] (Cameron *et al.*, 2011).

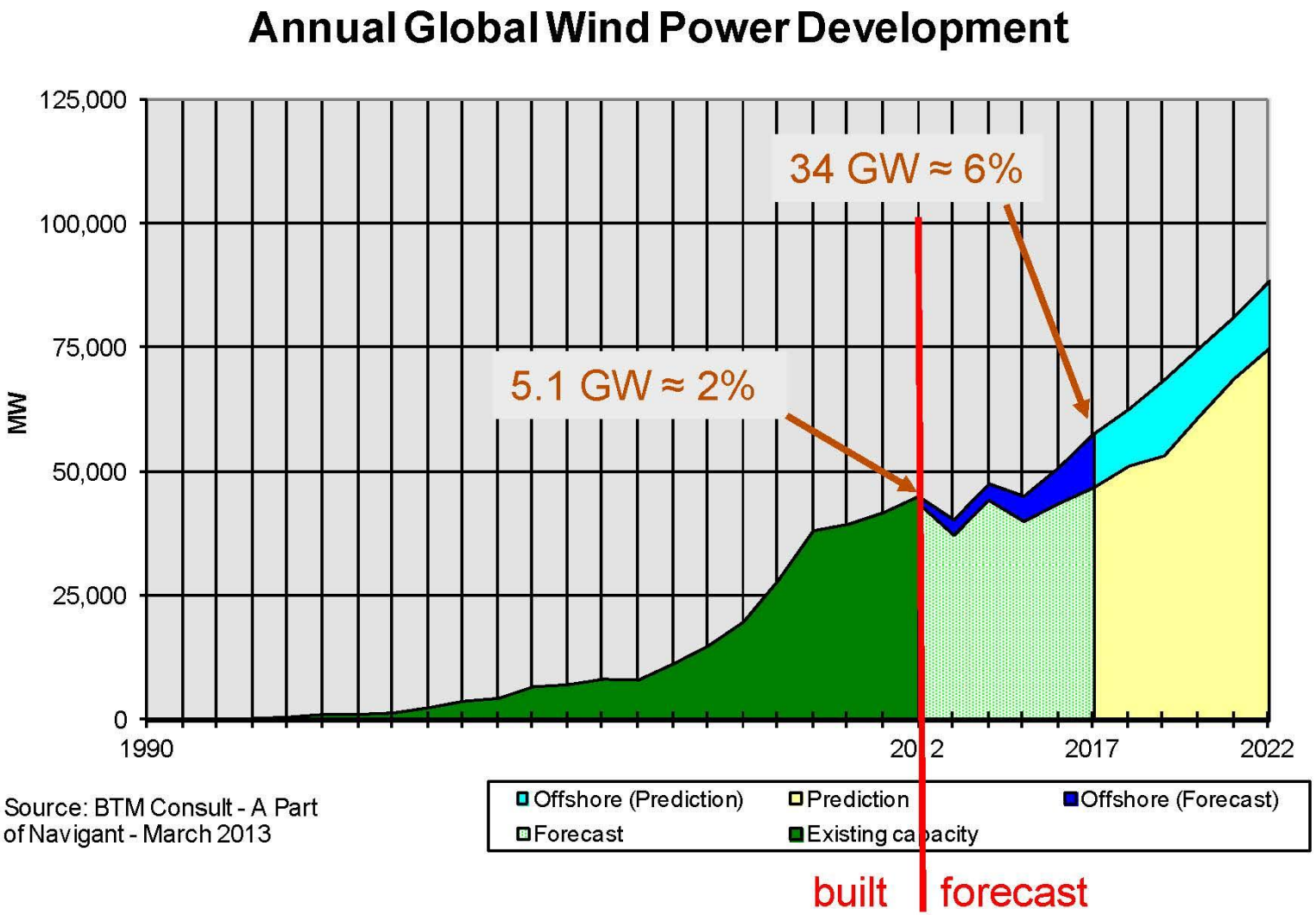
Windspeed. Roadmap to the deployment of Offshore Wind

Wind Capacity Potential

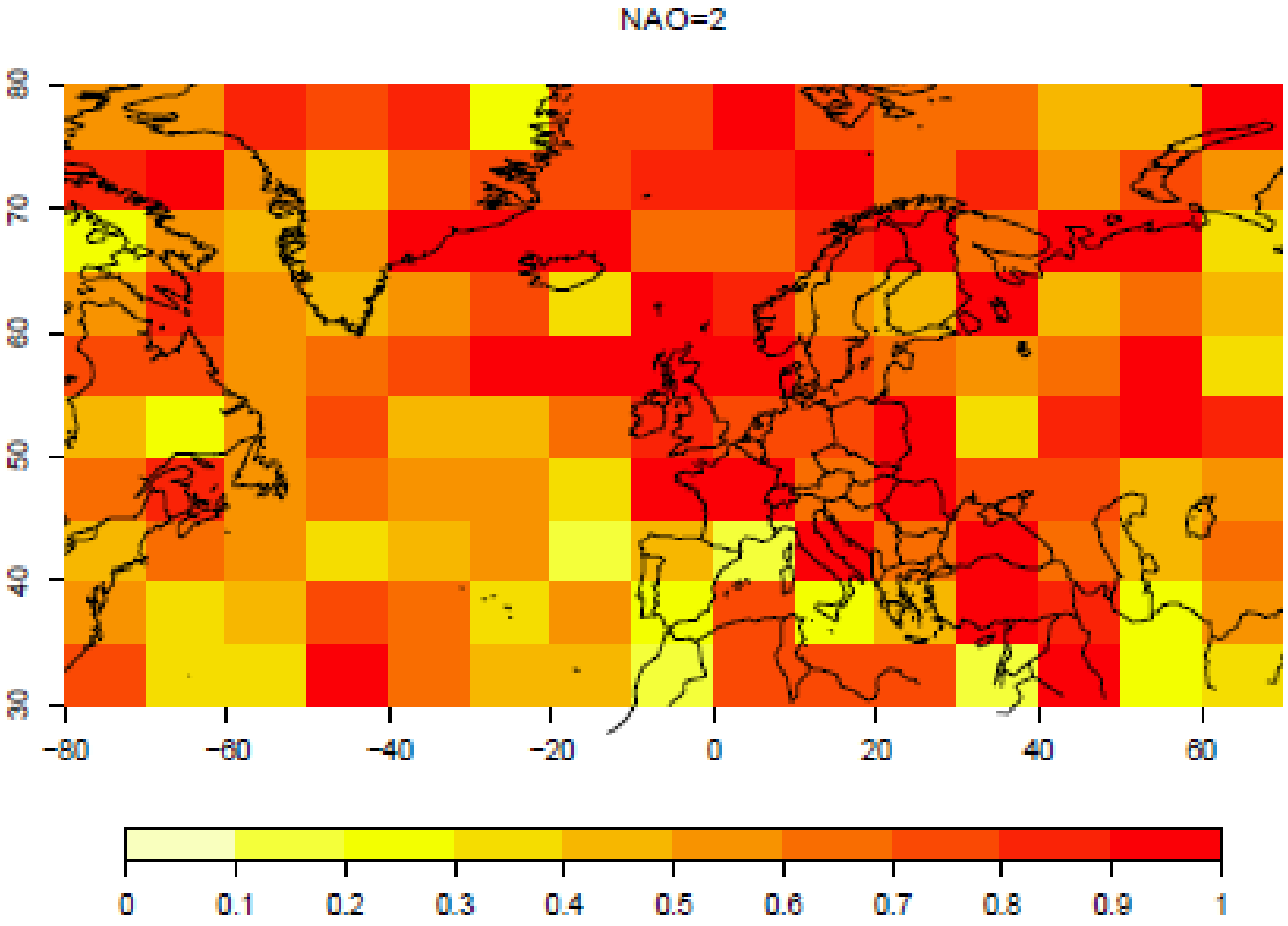


Windspeed. Roadmap to the deployment of Offshore Wind

Proportion of capacity from offshore

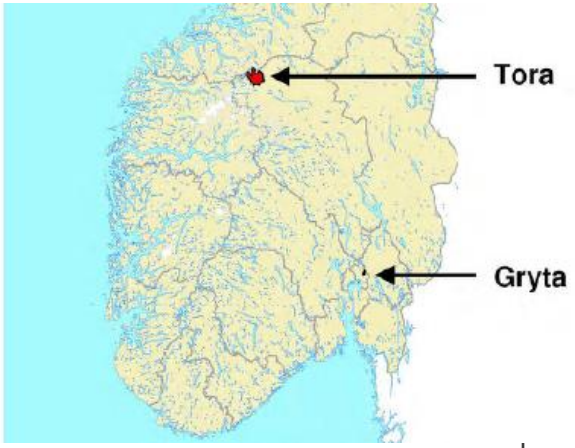


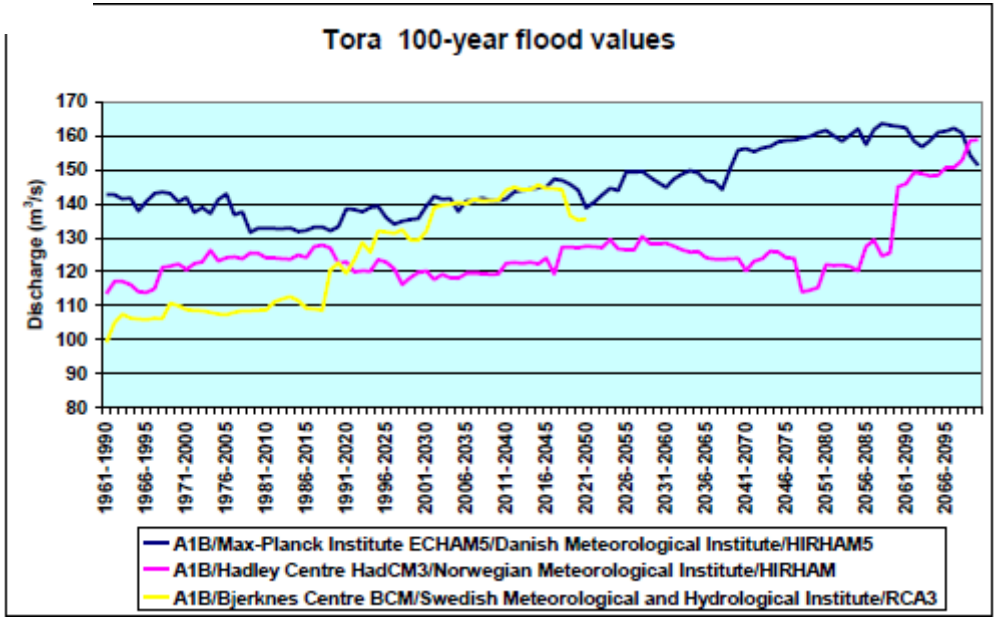
Very High Probability of Stronger Storms



Racewin project, Exeter Climate Systems and UK Met Office

Hydropwer and Norwegian Flooding

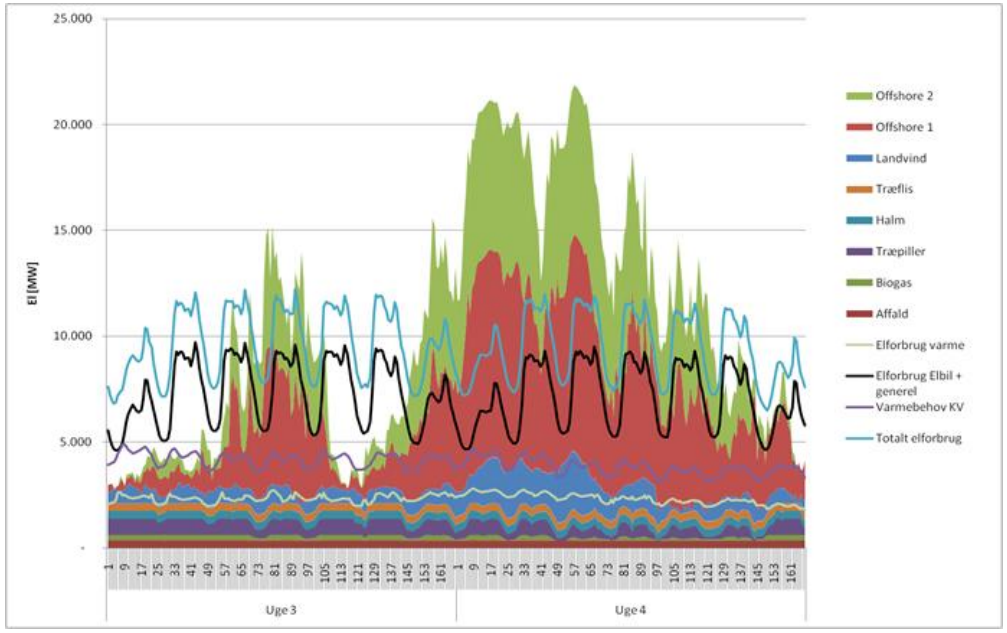




Climate Change and Energy Systems, Impacts, Risks and Adaptation in the Nordic and Baltic Countries, Tema Nord 2011

Integrated System Vulnerabilities to Extreme Weather Events

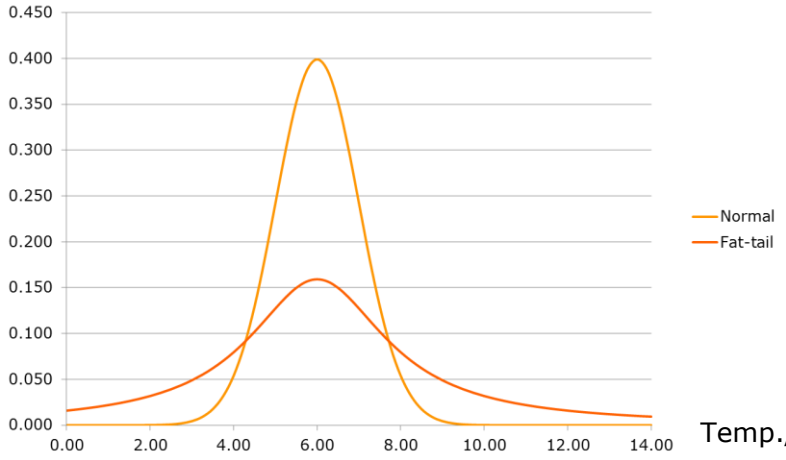
- System shocks originating from one source, which has a high system share:
  - Wind in Denmark – Market interrelation with NORDEL and Germany (hydropower, Nuclear)
  - Hydropower in Scandinavia – European market
- Synchronic shocks with system impact:
  - Storms can hit several plants and sources including nuclear and thermal
- Different location of plants can reduce synchronic shocks



Coping Strategies – Individual Technologies

- Use climate change forecasts in project planning: Mean values and extreme events
- Hydrower:
  - Consider dam construction
- Wind power:
  - Spread on different geographical locations
  - Stronger constructions
- Solar Power:
  - Resistent to hail, storms etc
- Biofuels:
  - Climate robust crops balanced with food production

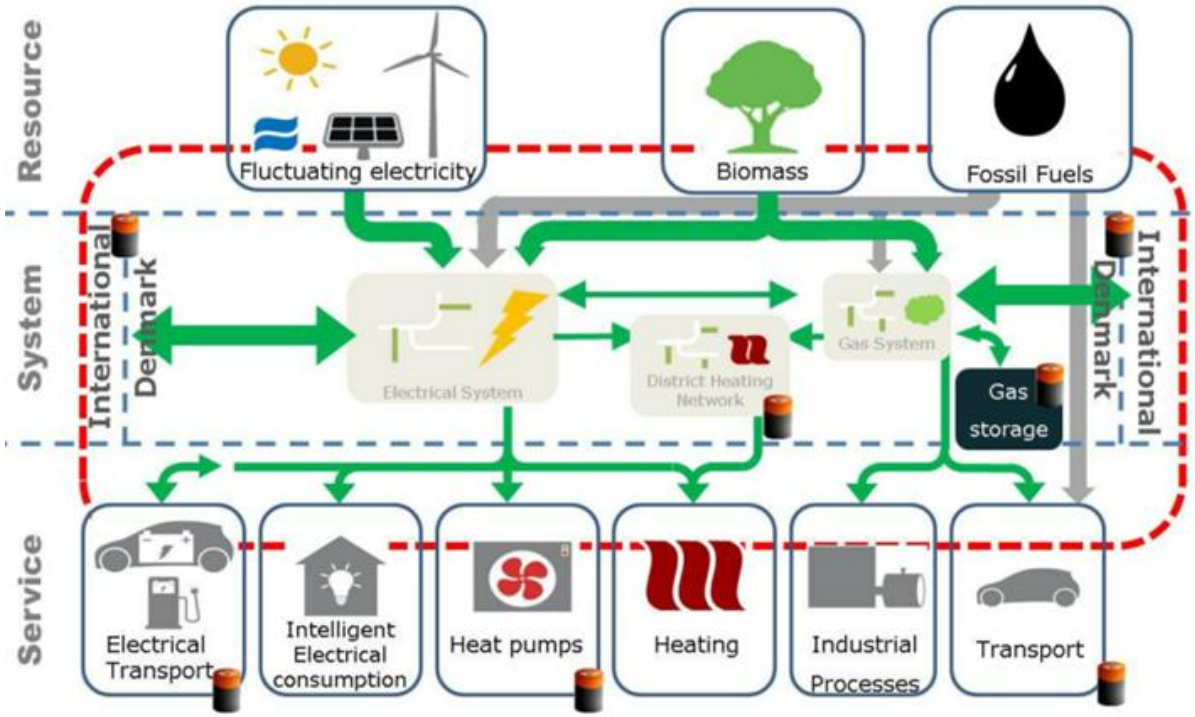
Climate pdf



Temp./Precipitation/Wind

Coping Strategies – Systems

- Use climate change forecasts in system management and planning
- Integrated modelling for the whole system and regional markets
- Storage facilities
- Uncertainty: Low probability/high consequence events
- New challenges in Smart Energy Systems with high shares of fluctuating energy

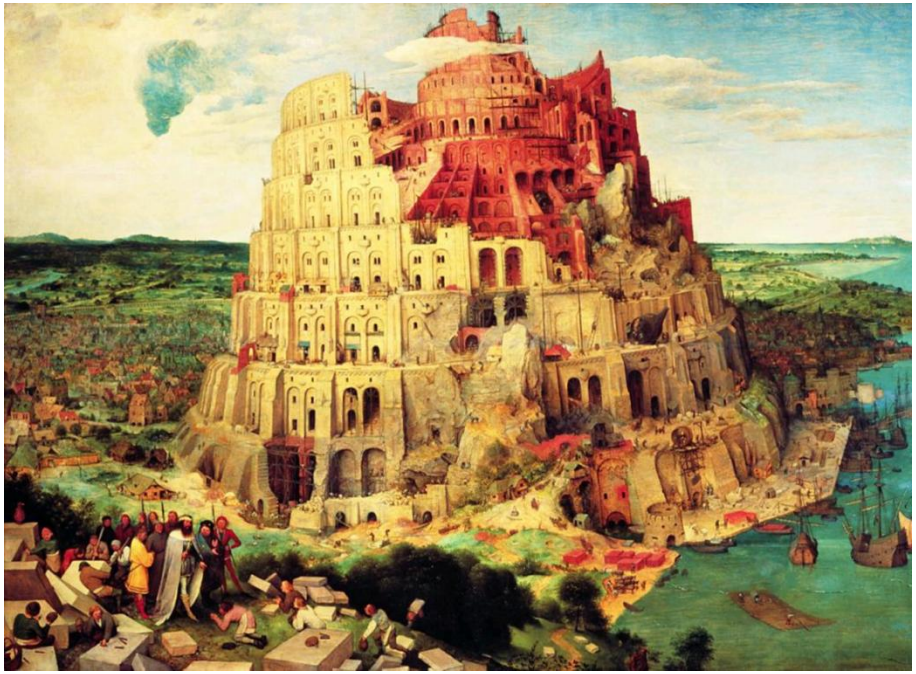


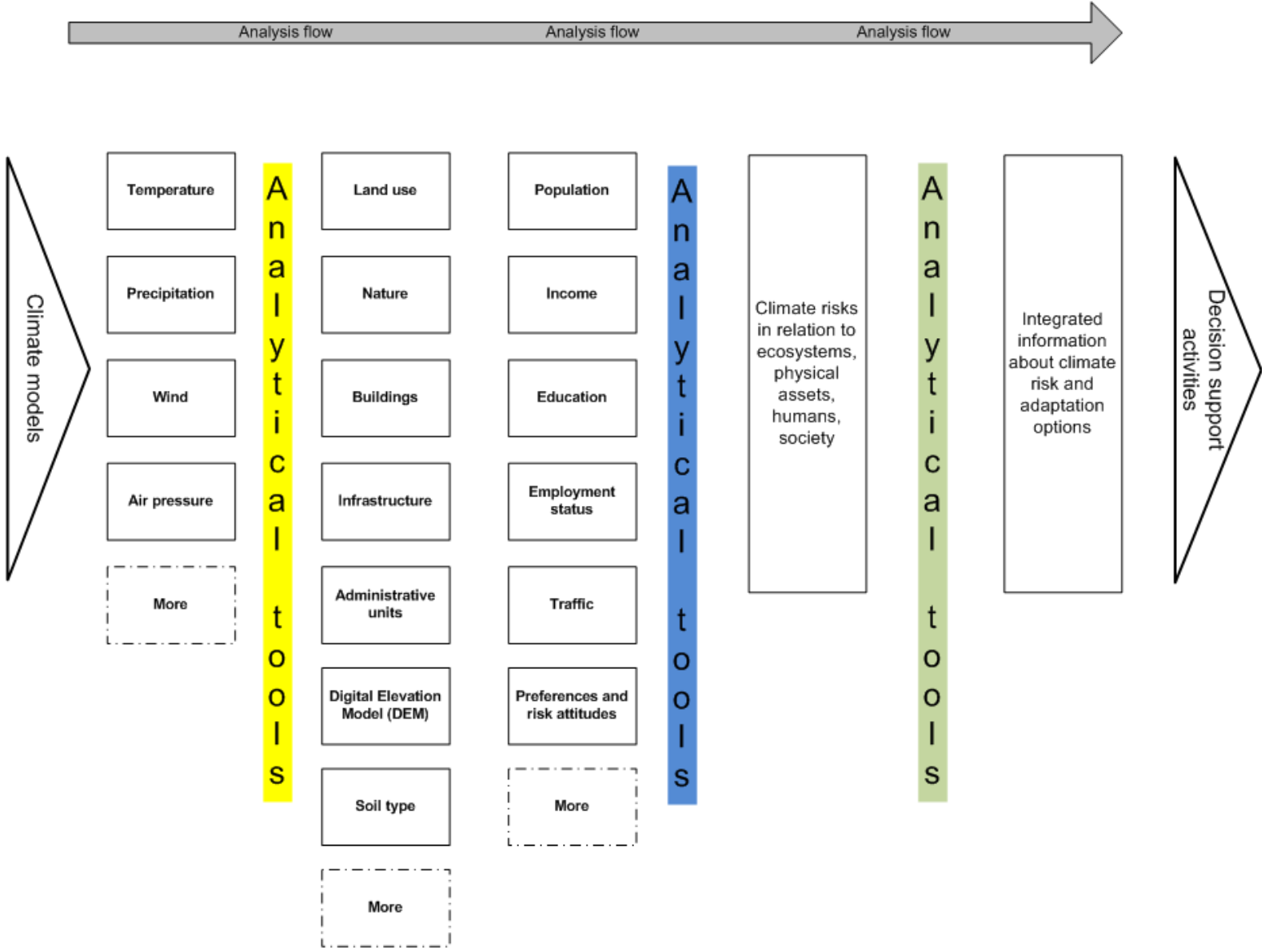
Markets and Finance

- Markets are a major coping mechanism with idio-synchronic shocks on renewable energy sources, but…….cross national climate proofing should be considered. Business model?
- Synchronic shocks on all energy conversion including thermal and nuclear are difficult to deal with – more backup capacity might be needed. Investors and business models?
- Consider climate risks in PPP projects
- Supply security insurance could be an option and not only for individual technologies

Research Ideas

- Climate proofing should be mainstreamed, but this will require multi-disciplinary work and empowerment of experts
- Energy experts should be active in Climate Service scoping including in the EU Horizon 2020
- Climate modellers should be asked the difficult questions e.g. about probability of extreme events. Accept large uncertainties
- Context specific integrated studies are needed




Analysis flow
Analysis flow
Analysis flow
Climate models
Temperature
Precipitation
Wind
Air pressure
More
Analytical tools
Land use
Nature
Buildings
Infrastructure
Administrative units
Digital Elevation Model (DEM)
Soil type
More
Population
Income
Education
Employment status
Traffic
Preferences and risk attitudes
More
Analytical tools
Climate risks in relation to ecosystems, physical assets, humans, society
Analytical tools
Integrated information about climate risk and adaptation options
Decision support activities